20
Block Diagrams

20.1 INTRODUCTION

The block diagram is one of the best ways of presenting a wealth of geological information in a compact, three-dimensional form. Almost at a glance, the relationships between the structural data plotted on the visible surfaces of the block can be integrated into a complete spatial picture. The construction of such a diagram entails drawing a scaled block, possibly adding topography to the upper surface, and representing the geologic structures on its top and sides, and perhaps within the block.

Such a scaled block may be constructed by the methods of descriptive geometry, but the procedure is fairly involved and time consuming. With the aid of a special net, a scaled cube may be constructed directly and in any orientation, and from this unit cube a block of any proportions may be obtained. To illustrate the use of this net, we will construct a block diagram with the geologic map of Fig. 20.1 on its top surface, together with the appropriate views of the other visible sides.

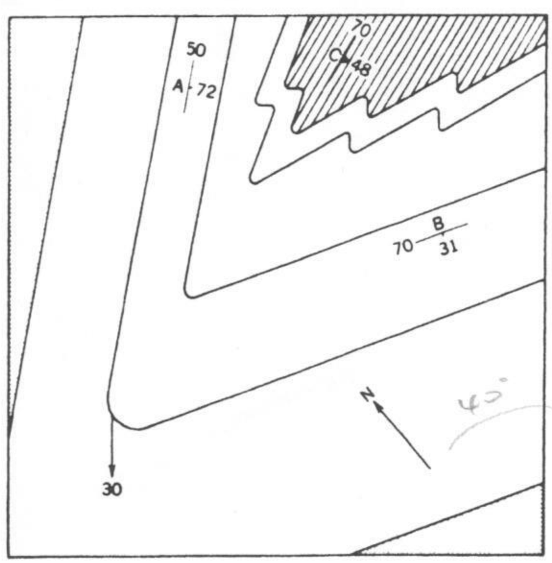


FIGURE 20.1 Geologic map for the top of a block diagram (after Lisle, 1980).

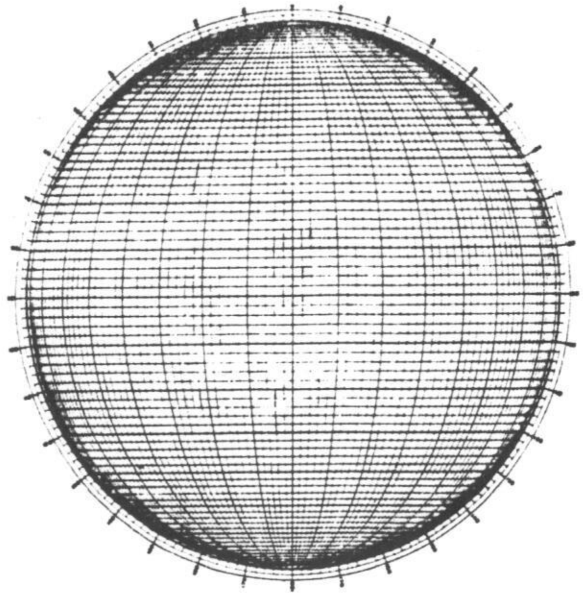


FIGURE 20.2 Orthographic net (from Wright, 1911).

20.2 ORTHOGRAPHIC NET

In both its form and use the orthographic net is closely related to the stereonet (Fig. 20.2). On its surface there is a grid composed of two families of curves. The set of curves related to the great circles of the stereonet are semi-ellipses, and the set related to the small circles are a series straight lines. Aside from these differences, the method of plotting points and planes, and performing rotations is the same as on the stereonet.

With this net, a scaled unit cube in any desired orientation can be constructed easily, as we will show in the next section. It should be noted that because of the close packing of the grid lines near the circumference of this net, it is often easier to count off complementary angles outward from the center than to count the angle itself inward from the primitive.

20.3 UNIT CUBE

The construction of the unit cube may be accomplished in two equivalent ways: by revolving the cube into any desired orientation, or by a direct plot. Because it aids visualization, the first method will be used to introduce the use of the orthographic net.

PROBLEM

Draw a cube using the map area of Fig. 20.1 as its top surface so that the line of sight is in a direction which plunges due north at 30°.

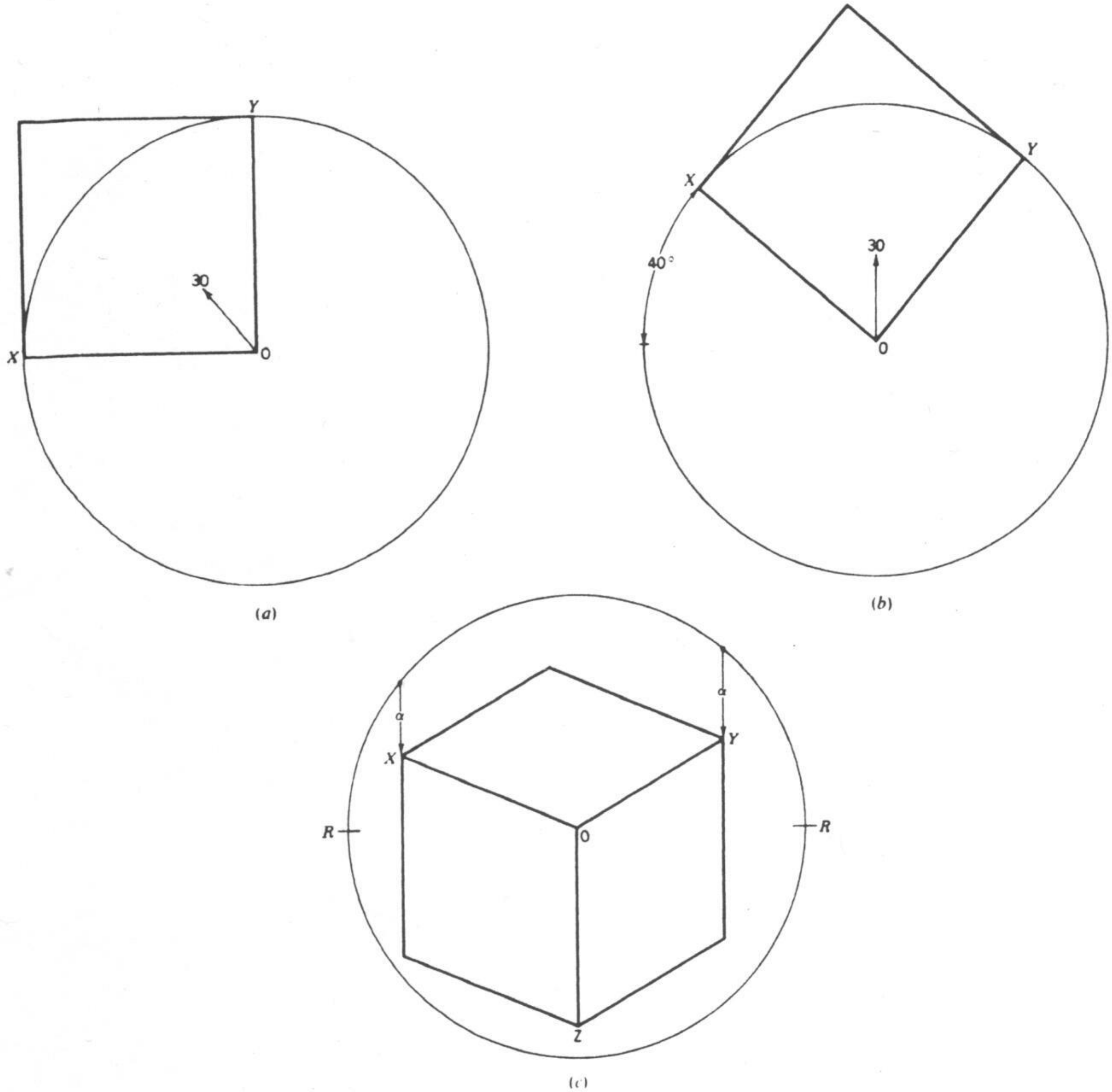


FIGURE 20.3 A unit cube on the orthographic net by rotation (after McIntyre and Weiss, 1956).

CONSTRUCTION BY ROTATION

1. On an overlay sheet with north marked, draw a square whose sides are equal to the radius of the orthographic net, located so that the front corner is at the center of the net (Fig. 20.3a).

2. First rotate this square to that the proposed line of sight trends due north. This takes a clockwise rotation of 40° (Fig. 20.3b).

3. Next rotate the block so that the plunging line of sight is at the center of the net. This manoeuver is performed in exactly the same way as it on the stereonet. First rotate the overlay 90° so the east-west rotational axis is parallel to the straight grid lines. To perform the rotation, all points move south along the straight "small circles" a distance of $\alpha = 60°$ (Fig. 20.3c).

4. The three lines x, y and z radiating from the center point O represent the solid angle made by the front three edges of the cube, and they appear in their correct foreshortened proportions. The cube is then completed by drawing in the other edges.

DIRECT PLOT (Fig. 20.4)

1. In its final position, the plane of the top of the block dips due north at 60°. This plane is represented by the "great circle" arc found by counting 30° outward from the center, which is then traced in.

2. To locate point X count off 50° anticlockwise from the point representing the true dip line along the arc. Point Y is similarly found by counting off 40° clockwise from this same point. As a check, the angular distance along the arc from X to Y must be 90°.

3. To locate point Z count off $\alpha = 60°$ from O southward along the radius of the net. A comparison with the results derived by rotation will show that they are the same. With these three points the cube can then be completed.

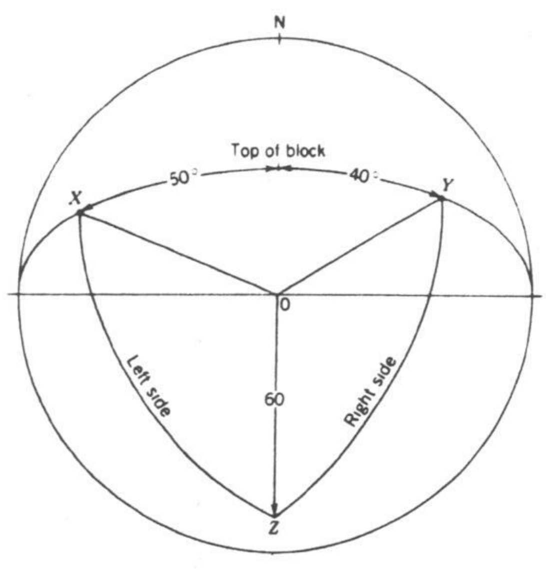


FIGURE 20.4 The unit cube by direct plot.

4. The arcs XZ and YZ representing the right and left vertical sides can be added to the diagram.

At this point, a simple proportional change in the lengths of the three lines representing the front edges of the cube can be made if the map has a rectangular shape.

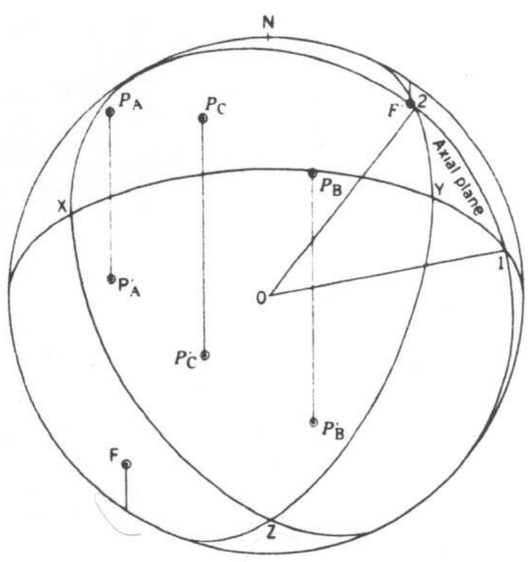
20.4 GEOLOGIC STRUCTURE

By constructing a grid on the geologic map and a equivalent foreshortened grid on the parallelogram representing the top of the cube the geological boundaries are transfered from the map to the top of the cube in much the same manner used in the construction of the fold profile in Fig. 10.10, except here the spacing of both sets of grid lines must be adjusted.

The next step is to determine the orientation of the traces of the various planar structures on the top and sides of the cube, and, if desired, the orientation of lines within the block. The basic approach is to plot the structural data as points on the net and then rotate these points into the cube coordinates.

CONSTRUCTION

1. Plot the poles of the bedding at points A and B on the limbs of the fold, the pole of the axial plane cleavage at C, and the plunging hinge line F exactly in the same way as they would be plotted on the stereonet.



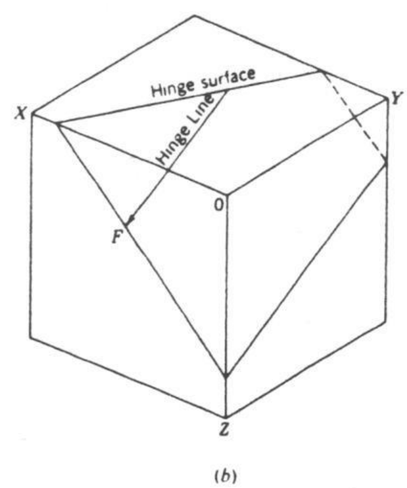


FIGURE 20.5 Traces of geologic structures: (a) found on the orthographic net; (b) transfered to the block (after Lisle, 1980).

2. Rotate these four points in the same direction and amount as the points X, Y and Z were rotated. Note that the point F moves to the primitive, reappears 180° opposite and continues its rotation.

3. With the new positions of the poles A, B and C, draw in the three corresponding great circular arcs. Only one of these planes is shown in Fig. 20.5a; it is the arc representing the axial plane cleavage at C.

4. Draw lines from the center O to the points of intersections the structural planes and the three faces of the cube. Again, only one of these is shown on the figure giving the orientation of the traces of the cleavage at C with the top (point 1) and the front right side (point 2). With these, the traces of planes parallel to C can be accurately drawn on the top and right sides. Usually the trace can be continued to the third side without further information from the net.

5. The orientation of the hinge line within the block is found by a line from O to F', and the hinge line can then drawn in from a hinge point on the map.

The completed block diagram, with the structure shown on all visible faces, as well as within the block, is shown in Fig. 20.6.

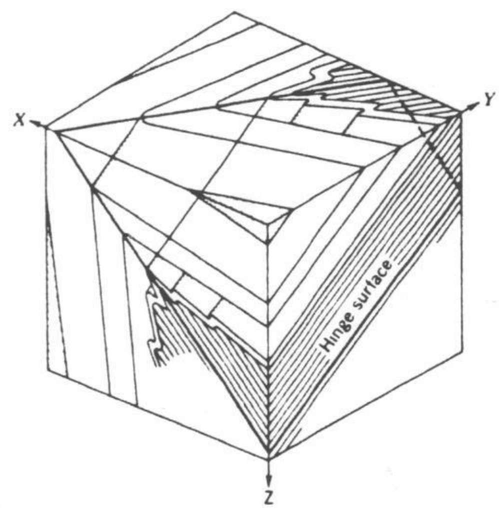
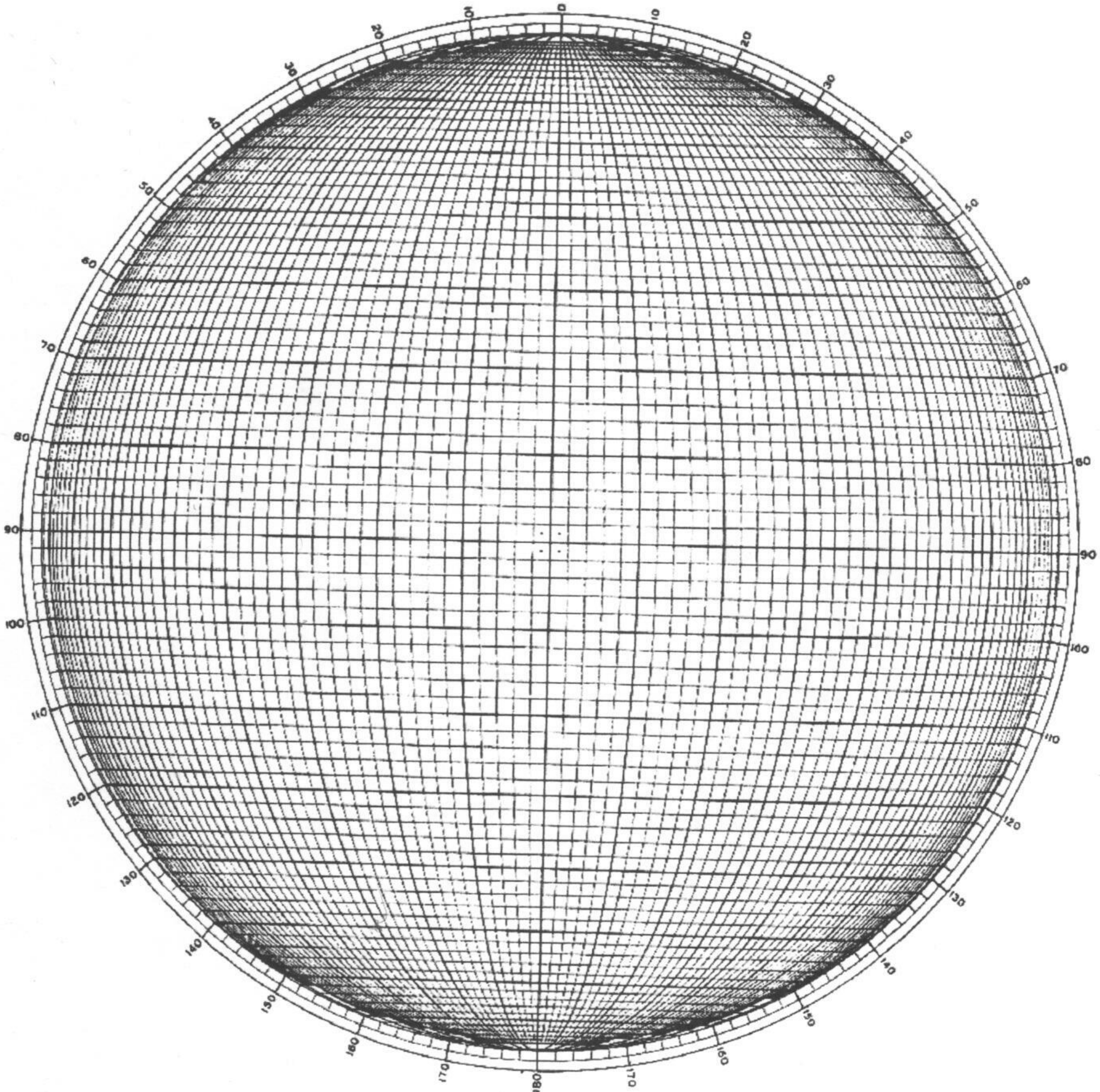


FIGURE 20.6 Completed block diagram (after Lisle, 1980).

20.5 TOPOGRAPHY

If the area has even a small amount of relief, the three-dimensional aspect of the block may be enhanced by adding topography to the diagram. A number of systems for doing this have been devised to adjust map topography systematically to the proportions and scales of the block diagram. The easiest approach method uses a rela-



ORTHOGRAPHIC NET